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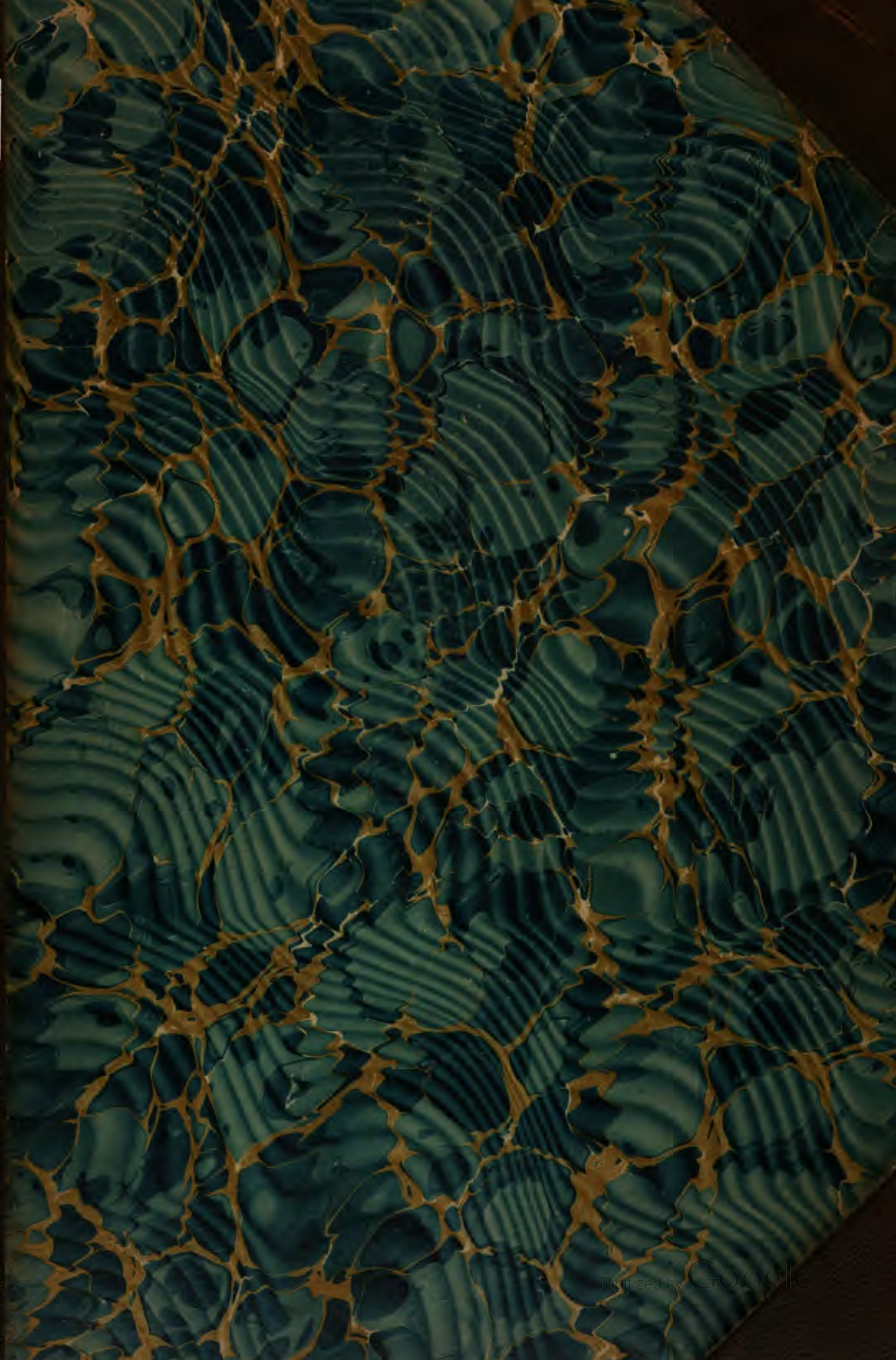

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Dr. Hodgkin
with the Author's kind regards

SOME OBSERVATIONS ON FISH

IN

RELATION TO DIET.

3f

BY

JOHN DAVY, M.D., F.R.SS. LOND. AND EDIN.,

INSPECTOR-GENERAL OF ARMY HOSPITALS, ETC.

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XLII.—*Some Observations on Fish, in relation to Diet.* By JOHN DAVY, M.D., F.R.S. Lond. & Edin., Inspector-General of Army Hospitals, &c.

(Read 18th April 1853.)

What are the nutritive qualities of fish, compared with other kinds of animal food? Do different species of fish differ materially in degree in nutritive power? Have fish, as food, any peculiar or special properties? These are questions, amongst many others, which may be asked, but which, in the present state of our knowledge, I apprehend it would be difficult to answer in a manner at all satisfactory.

On the present occasion, I shall attempt little more than an opening of the inquiry, and that directed to a few points,—chiefly those alluded to in the foregoing queries.

1. *Of the Nutritive Power of Fish.*

The proposition probably will be admitted, that the nutritive power of all the ordinary articles of animal food, at least of those composed principally of muscular fibre, or of muscle and fat, to whatever class belonging, is approximately denoted by their several specific gravities, and by the amount of solid matter which each contains, as determined by thorough drying, or the expulsion of the aqueous part, at a temperature such as that of boiling water, not sufficiently high to effect any well-marked chemical change.

In the trials I have made, founded on this proposition, the specific gravity has been ascertained in the ordinary hydrostatical way;—the portions subjected to trial, in the instance of fish, have been taken from the thicker part of the back, freed from skin and bone, composed chiefly of muscle. And the same or similar portions have been used for the purpose of determining their solid contents, dried in platina or glass capsules of known weight, and exposed to the process of drying till they ceased to diminish in weight.

The trials on the other articles of diet, made for the sake of comparison, both as regards specific gravity (excepting the liquids), and the abstraction of the hygroscopic water, or water capable of being dissipated by the degree of temperature mentioned, have been conducted in a similar manner.

The balance used was one of great delicacy, at home, or a small portable one, when from home, of less delicacy, yet turning readily with one-tenth of a grain.

The results obtained are given in the following tables. In the first, on some different species of fish; in the second, on some other articles of animal food.

I have thought it right, whenever it was in my power, to notice not only the time when the fish were taken, but also the place where they were procured,—not

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always so precise as I could wish,—as both season and locality may have an influence on their quality individually. When the place mentioned is inland, it must be understood, that, in the instance of sea-fish, they were from the nearest seaport.

TABLE I.

Species of Fish.	Specific Gravity.	Solid Matter, per cent.	Place where got, and Time.
Turbot, *Rhombus maximus*,	1062	20·3	March. Liverpool.
Brill, *R. vulgaris*, . .	1061	20·2	October. Penzance.
Haddock, *Gadus æglefinus*,	1056	20·2	August. Ambleside.
Hake, *G. merlucius*, .	1054	17·4	October. Penzance.
Pollack, *G. pollachius*, .	1060	19·3	October. Penzance.
Whiting, *Merlangus vulgaris*,	1062	21·5	March. Chester.
Common Cod, *Morrhua vulgaris*,	1059	19·2	April. Ambleside.
Red Gurnard, *Trigla cuculus*,	1069	23·6	October. Penzance,
Dory, *Zeus faber*, . .	1070	22·9	October. Penzance.
Mackerel, *Scomber scombrus*,	1043	37·9	October. Penzance.
Sole, *Solea vulgaris*, .	1065	23·0	February. Ambleside.
Do. *do.*, . .	1064	21·1	February. Ambleside.
Thornback, *Raia clavata*,	1061	22·2	October. Penzance.
Salmon, *Salmo salar*, .	1071	29·4	March. River Boyne, Ireland. Fresh run from the sea.
Sea-Trout, *S. eriox*, .	...	41·2	June. Ambleside.
Charr, *S. umbla*, . .	1056	22·2	November. Windermere.
Trout, *S. fario*, . .	1053	22·5	March. Lough Corrib, Ireland, Weight about ½ lb., in good condition.
Do. *do.* . .	1050	18·7	October. River Brathay. A small fish of about 2 oz.
Smelt, *S. eperlanus*, .	1060	19·3	March. Liverpool.
Eel, *Anguilla latirostris*,	1034	33·6	June. Ambleside.

TABLE II.

Kinds of Food.	Specific Gravity.	Solid Matter, per cent.	Place and Time.
Beef, sirloin, . . .	1078	26·9	March. Ambleside.
Veal, loin, . . .	1076	27·2	November. Ambleside.
Mutton, leg, . . .	1069	26·5	November. Ambleside.
Pork, loin, . . .	1080	30·5	January. Ambleside.
Pemican, composed of beef and suet, . . .	...	86·25	Victualling-yard, Portsmouth.
Common fowl, breast, .	1075	27·2	November. Ambleside.
Grey Plover, breast, .	1072	30·1	November. Ambleside.
Cow's milk, new, before the cream had separated, .	1031	11·2	November.
White of hen's egg, .	1044	13·9	
Yolk of the same, .	1032	45·1	

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These results I would wish to have considered merely as I have proposed in introducing them, viz., as approximate ones. Some of them may not be perfectly correct, owing to circumstances of a vitiating kind, especially the time of keeping. Thus, in the case of the whiting, which was brought from Chester, its specific gravity, and its proportion of solid matter may be given a little too high, owing to some loss of moisture before the trials on it were made. Casting the eye over the first table, it will be seen that the range of nutritive power, as denoted by the specific gravity, and the proportion of solid matter, is pretty equable, except in a very few instances, and chiefly those of the salmon and mackerel. The one exhibiting a high specific gravity, with a large proportion of solid matter; the other, a low specific gravity, with a still larger proportion of matter, viz., muscle and oil, and, in consequence of the latter, the inferior specific gravity. A portion of the mackerel, I may remark, merely by drying and pressure between folds of blotting paper, lost 15·52 per cent. of oil. Oil also abounded in the sea-trout and eel, and hence the large amount of residue they afforded.

Comparing *seriatim* the first table with the second, the degree of difference of nutritive power of those articles standing highest in each, appears to be inconsiderable, and not great in the majority of the others, exclusive of the liquids,—hardly in accordance with popular and long received notions.

2. *Of the Peculiar Qualities of Fish, as Articles of Diet.*

I am not prepared to enter into any minute detail on this important subject, from want of sufficient data.

That fish generally are easy of digestion, excepting such as have oil interfused in their muscular tissue, appears to be commonly admitted, as the result of experience,—a result that agrees well with the greater degree of softness of their muscular fibre, comparing it with that either of birds or of the mammalia, such as are used for food.

A more interesting consideration is, whether fish, as a diet, is more conducive to health than the flesh of the animals just mentioned, and especially to the prevention of scrofulous and tubercular disease.

From such information as I have been able to collect, I am disposed to think that they are. It is well known that fishermen and their families, living principally on fish, are commonly healthy, and may I not say above the average; and I think it is pretty certain, that they are less subject to the diseases referred to than any other class, without exception. At Plymouth, at the Public Dispensary, a good opportunity is afforded of arriving at some positive conclusion—some exact knowledge of the comparative prevalency of these diseases in the several classes of the community. The able physician of that institution, my friend, Dr Cookworthy, at my request, has had the goodness to consult its records, and from a communication with which he has favoured me, it appears that of 654 cases of

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"confirmed phthisis and of hæmoptysis, the probable result of tuberculosis," entered in the register of the Dispensary, 234 males, 376 females, whose ages and occupations are given individually, the small number of four only were of fishermen's families,—one male and three females,—which is in the ratio of one to 163·2; and of watermen "who fish with hook and line, when other work is scarce, generally very poor, and of habits generally by no means temperate or regular," the number, including their families, did not exceed eleven, of whom ten were males, one a female, which is in the ratio of one to 58·8. The entries from which the 654 cases are extracted, Dr COOKWORTHY states, exceed 20,000. He assures me, that had he taken scrofula in all its forms, the result would, he believes, have been more conclusive.

Such a degree of exemption as this return indicates in the instances of fishermen and boatmen, is certainly very remarkable, and deserving of attention, especially considering the prevalency of tubercular consumption, not only in the working classes generally throughout the United Kingdom, but also amongst the regular troops, whether serving at home or abroad, and having an allowance of meat daily, but rarely tasting fish.*

If the exemption be mainly owing to diet, and that a fish diet, it may be presumed that there enters into the composition of fish, some element not common to other kinds of food, whether animal or vegetable. This I believe is the case, and that the peculiar element is iodine.

I may briefly mention, that in every instance in which I have sought for this substance in sea-fish, I have found distinct traces of it, and also, though not so strongly marked, in the migratory fish, but not in fresh-water fish. The trials I have hitherto made have been limited to the following, viz., the Red Gurnet, Mackerel, Haddock, Common Cod, Whiting, Sole, Ling, Herring, Pilchard, Salmon, Sea-Trout, Smelt, and Trout. In each instance, from about a quarter a pound to a pound of fish was dried and charred, lixiviated, and reduced to ashes, which were again washed. From the sea-fish, the washings of the charcoal afforded a good deal of saline matter on evaporation; the washings of the ash less. The saline matter from both consisted principally of common salt, had a pretty strong alkaline reaction, and with starch and aqua regia, afforded, by the blue hue produced, clear proof of the presence of iodine. In the instance of the fresh-run Salmon, Sea-Trout, and Smelt, a slight trace of iodine was thus detected; in the spent Salmon descending to the sea, only a just perceptible trace of it was observable, and not a trace of it either in the Parr or in the Trout.

That iodine should enter into the composition of sea-fish, is no more perhaps than might be expected, considering that it forms a part of so many of the inhabi-

* In 1205 fatal cases, not selected, in which the lungs were examined at the General Hospital, Fort Pitt, Chatham, tubercles were found to exist in 734 (61·7 per cent.) See the author's "Notes on the Ionian Islands and Malta," vol. ii., p. 312, for details.

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tants of the sea on which fish feed;—to mention only what I have ascertained myself,—in the common Shrimp I have detected it in an unmistakeable manner, and also in the Lobster and Crab; and likewise in the common Cockle, Mussel, and Oyster.

The medicinal effects of cod-liver oil, in mitigating if not in curing pulmonary consumption, appear to be well established. And as this oil contains iodine, the analogy seems to strengthen the inference that sea-fish generally may be alike beneficial.

Should further inquiry confirm this conclusion, the practical application of it is obvious; and fortunately, should fish ever come into greater request as articles of food, the facility with which they may be preserved, even without salt, by thorough drying, would be much in favour of their use. I lay stress on thorough drying, as that seems essential,—for preservation, I believe even hygroscopic water should be excluded. Even in the instance of those articles of food which can be preserved in their ordinary dry state, the expulsion of this water would be advantageous under certain circumstances, were it merely on account of diminution of weight. Thus, referring to the second table, it will be seen that the Pemican, carefully prepared in the Portsmouth Victualling Office, lost by thorough drying 13·75 per cent., so much being the water it contained in a hygroscopic state,—a lightening of weight that, to the Arctic land explorer, could not fail to be welcome and useful.

The inference regarding the salutary effects of fish depending on the presence of iodine, in the prevention of tubercular disease, might be extended to some other diseases, especially to that formidable malady goître, the mitigation or cure of which has, in so many instances, been effected by iodine; and which, so far as I am aware, is entirely unknown amongst the inhabitants of seaports and sea-coasts, who, from their situation, cannot fail to make more or less use of fish.

Amongst the many questions that many be asked in addition to those I have proposed, I shall notice one more only, and that in conclusion. It is, whether the different parts of the same fish are likely to be equally beneficial in the manner inferred,—the beneficial effect, it is presumed, depending on the presence of iodine. From the few experiments I have yet made, I am led to infer, reasoning as before, that the effects of different parts will not be the same, inasmuch as their inorganic elements are not the same. I may instance liver, muscle, and roe or milt. In the ash of the liver and muscle of sea-fish, I have always found a large proportion of saline matter, common salt abounding, with a minute portion of iodine,—rather more in the liver than in the muscle,—and free alkali, or alkali in a state to occasion an alkaline reaction, as denoted by test paper; whilst in their roe and milt I have detected very little saline matter, no trace of iodine, or of free alkali; on

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the contrary, a free acid, the phosphoric, analogous to what occurs in the ash of the yolk of the domestic fowl,—and in consequence of which, the complete incineration of the roe of the fish and its milt, like that of the yolk of the egg, is very difficult.

The same conclusion, on the same ground, viz., the absence of iodine, is applicable to fresh-water fish,—a conclusion that can hardly be tested by experience, nor is it of practical importance, since fish of this kind enters so sparingly into the ordinary diet of the people.

Lesketh How, Ambleside,
April 14, 1853.

P.S.—I have mentioned briefly the test employed to detect iodine. To prevent obscurity, may I be permitted to add a few particulars relative to the mode of proceeding? On a portion of starch in fine powder, that is, in its granular state, aqua regia is poured, or about equal parts of nitric and muriatic acid, in a platina capsule, and then well mixed, using a glass rod. The salt to be tested, either in solution or solid, is then added. The blue tint due to the presence of iodine is immediately produced, if any of this substance, or a sufficiency of it to take effect, be present. The delicacy of this test is, I believe, well known. I have by means of it detected iodine, when one-tenth of a grain of the iodide of potassium was dissolved in 16775 grains of water. Relative to this method, I may further remark, that by well mixing the acid and starch, not only is the starch reduced to a gelatinous state favourable for being acted on by the iodine as liberated, by the action of the chlorine, but also that the excess of chlorine is, to a great extent, got rid of. The platina capsule has appeared preferable to one of glass, as shewing the effect of colour by reflected light more readily and distinctly; and also, I am disposed to think, from some peculiar influence which the metal exercises, favouring the combination of the starch and iodine, similar, it may be, to that of spongy platinum, in effecting the union of oxygen and hydrogen.

In seeking for iodine in animal substances by incineration, it may be well to keep in mind, that, experimentally considered, the liability to error lies in underrating, rather than in overrating the result by the methods employed, and that mainly in consequence of more or less of loss of iodine being sustained in the process of combustion, incineration, and evaporation used. To illustrate this by a simple experiment, I may mention that a portion of water, equivalent to about 1525 grains, in which were dissolved 10 grains of common salt, and ·09 grain of iodide of potassium, was quickly evaporated to dryness by boiling. Previously, the iodine could be detected in the mixture by the test I have used; but not afterwards, when the

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residual salt was dissolved in the same quantity of water; proving how there had been a loss of the iodine in the operation of boiling; a loss chemists are familiar with, of substances in themselves not volatile, carried off suspended in aqueous vapour.

In stating the comparative exemption of fishermen and their families from pulmonary consumption, as indicated by the Plymouth Dispensary return, I have not given the total number of this class of persons. This deficiency I am now able to supply. From information which I have received, for which I am indebted to the Registrar-General, it would appear, that of the total male population of Plymouth (24,605), the number of fishermen is 726, exclusive of 37 pilots. This large proportional number renders the fact of their exemption the more remarkable, and especially comparing them with a class of the population, altogether different in their habits, and, it may be presumed in their diet, using fish only occasionally when abundant and cheap,—these are the cordwainers or shoemakers, whose number altogether (males) is 608. Now, on consulting the Dispensary return, I find, that the total number of this class that have died of the disease under consideration, has been 37, viz., 19 males and 18 females!

Reflecting on the fact, that iodine has been detected in all the trials I have hitherto made on sea-fish, it seemed probable that guano, considering its origin, would not be destitute of this substance; and the result of experiments has been confirmatory; using the test-method noticed above, a distinct indication of its presence was obtained, both in the instance of the Peruvian and African guano, the only two I have yet tried.

Lesketh How, *June* 1, 1853.

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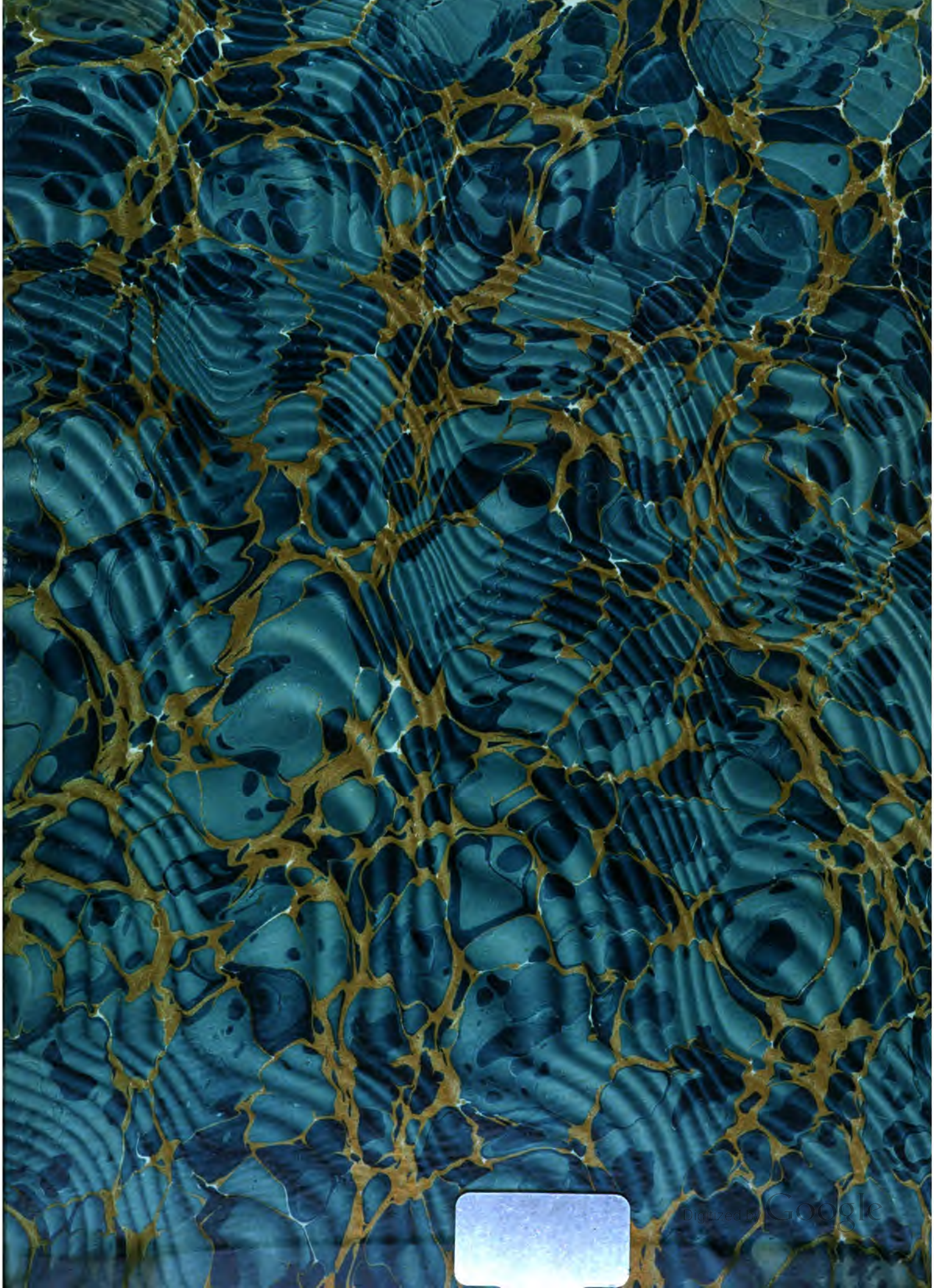
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